290-14

BIG CREEK

INITIAL DEVELOPMENT

Hydro-Electric Power Station

PACIFIC LIGHT & POWER CORPORATION

PACIFIC LIGHT & POWER CORPORATION

INITIAL DELEGATION

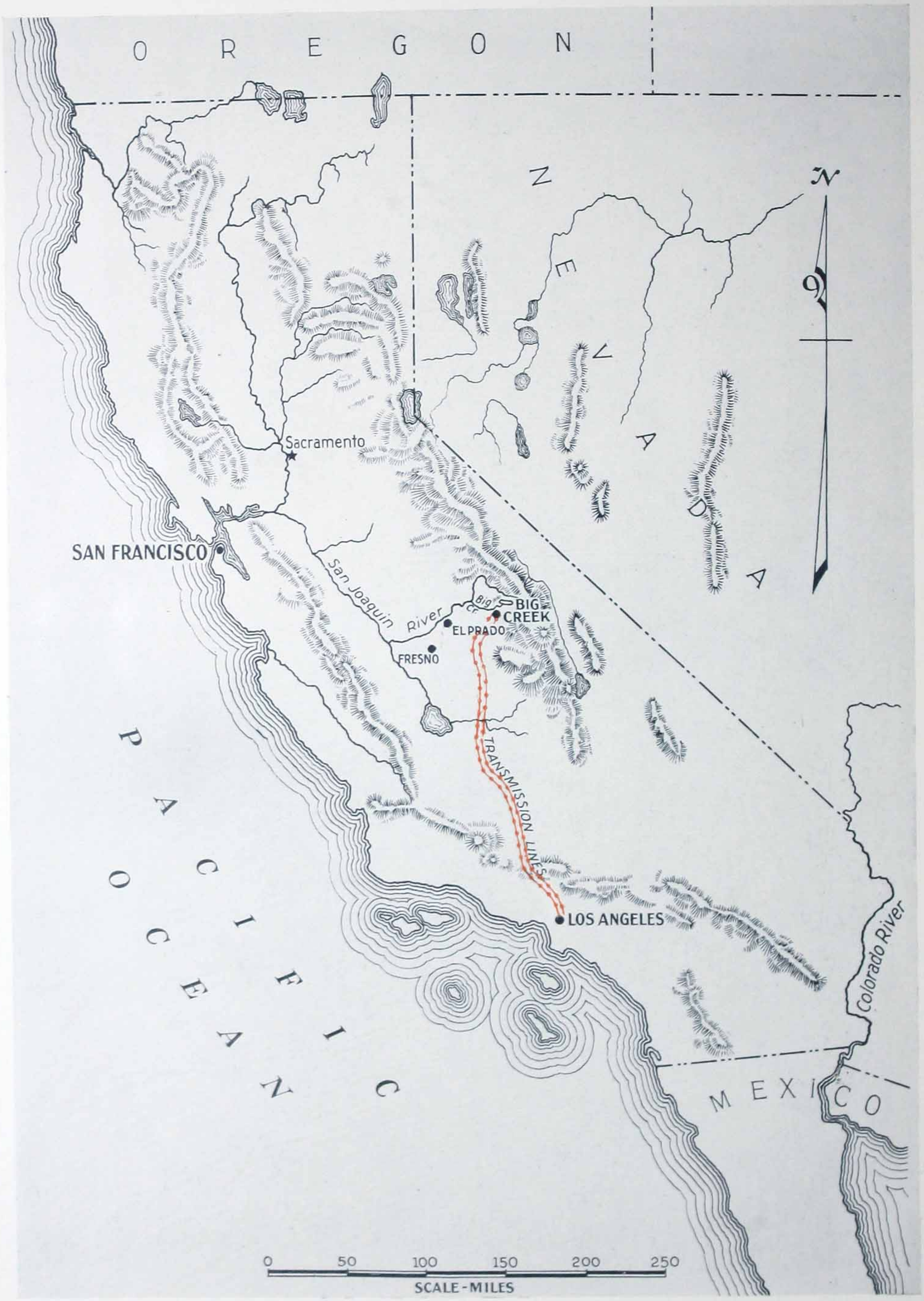
BIG CREEK

BIG CREEK
INITIAL DEVELOPMENT
1914

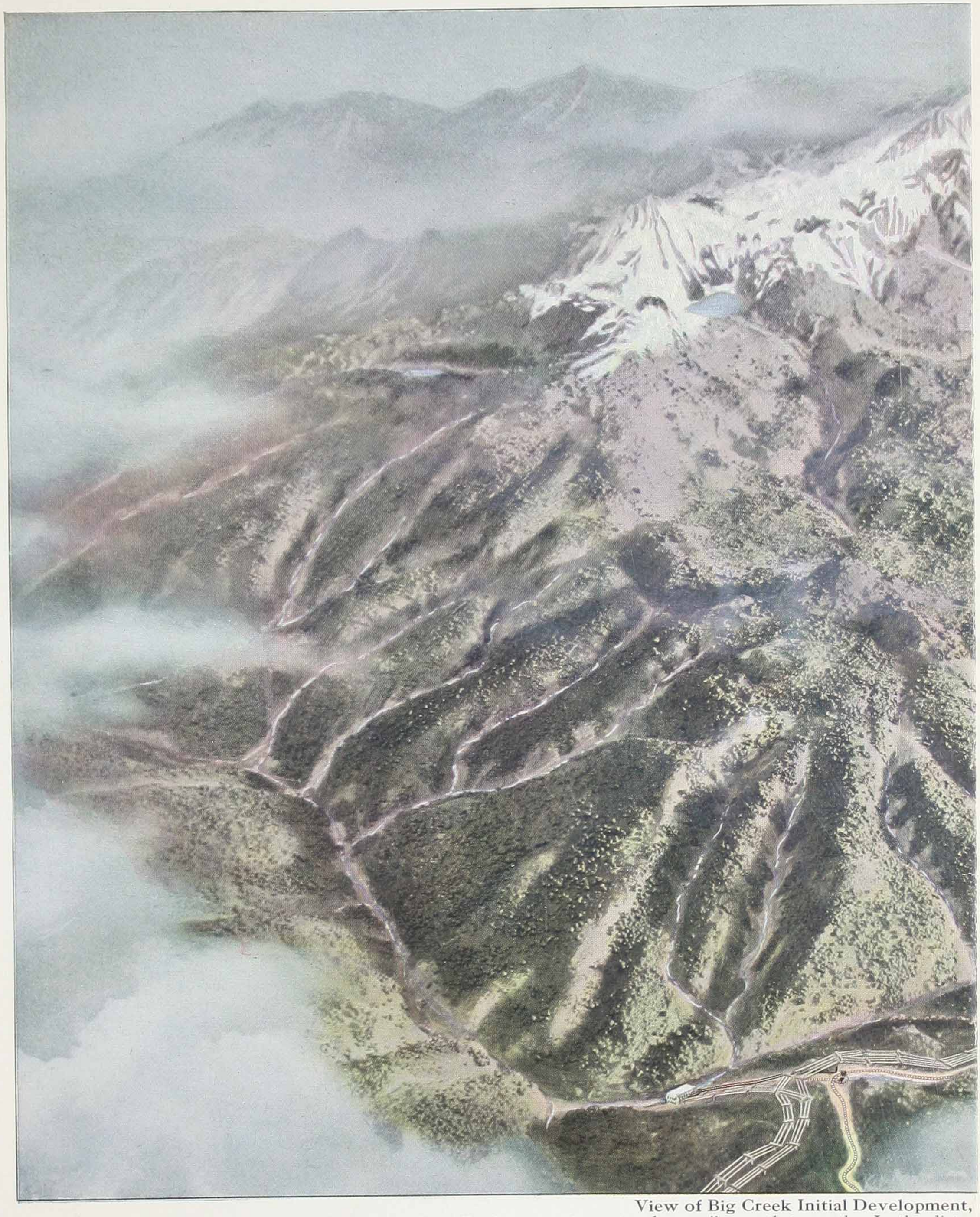
Four Dams
Two Tunnels
Two Power Houses
Two 240 Mile
Transmission Lines
Sub Station
56 Mile Railroad

PACIFIC LIGHT & POWER CORPORATION

STONE & WEBSTER CONSTRUCTION COMPANY
CONSTRUCTING ENGINEERS

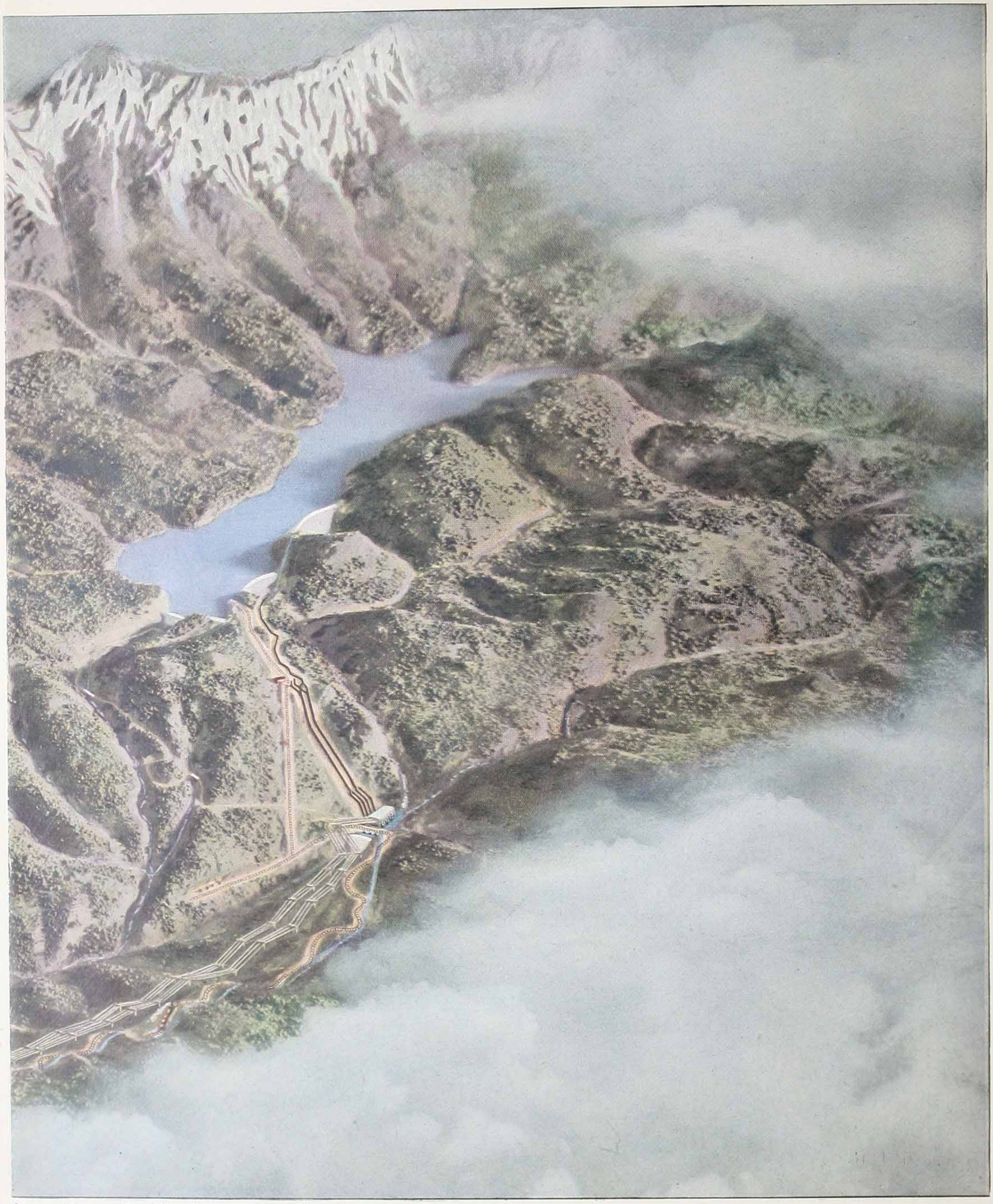


Map of California Showing Big Creek Transmission Lines



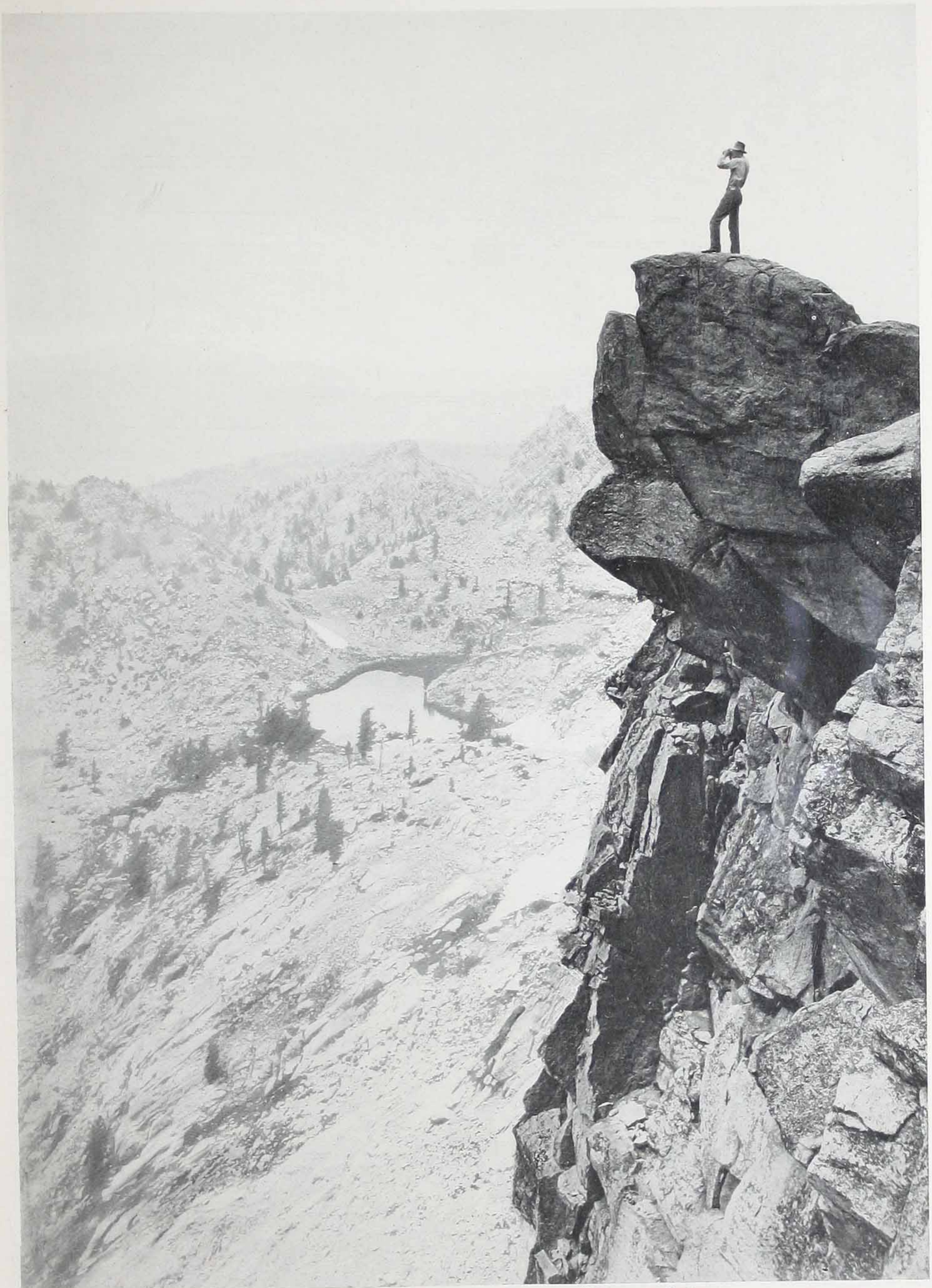
View of Big Creek Initial Development,

The area included is about twelve miles from east to west and ten miles north to south. In the distan
Reservoir (elevation 7000 feet). Power House Number One (elevation 5000 feet) lies at the head of Bi
same canyon, four miles to the west. Below Power House Number Two B



from Above the Clouds, Looking Northeast

ce is Kaiser Crest (elevation 11,000 feet) with a portion of the Drainage Area surrounding the Storage
g Creek Canyon in the right foreground, and Power House Number Two (elevation 3000 feet) is down the
ig Creek enters the canyon of the San Joaquin River, running south and west.



Observer on Kaiser Crest at Eleven Thousand Feet

Having crossed the Big Creek Basin and reached the summit, he is looking back over the territory shown in the aerial view opposite

Dam No. 1

Gravity Section, containing 59,000 yards of concrete. Initial height 132 feet, length 812 feet, thickness at base 116 feet

Big Creek Initial Development

The completion of the initial development at Big Creek for the Pacific Light & Power Corporation is noteworthy because it involves unusual natural conditions, unusual engineering problems and an unusual commercial accomplishment.

It is by far the largest high head development in this country. The most powerful impulse wheels ever built drive the largest electric generators of their type.

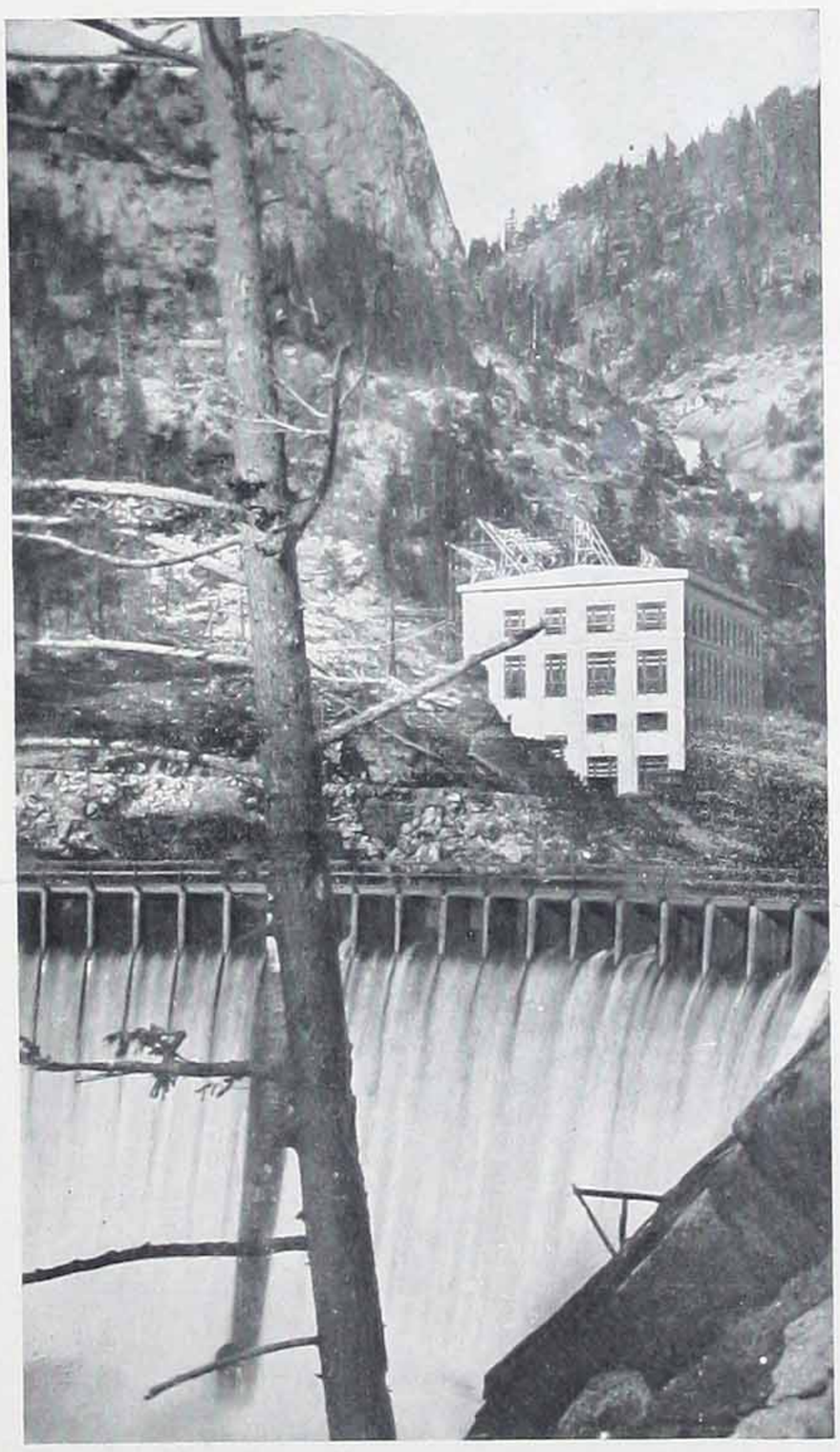
The transmission line is the longest "express" line in existence and will operate at the highest voltage ever used commercially. It carries power 240 miles from a remote spot in the mountains halfway between San Francisco and Los Angeles to commercial use in the latter city and adjacent territory.

A preliminary to the construction work proper was the building of a railroad 56 miles long to reach the site of the development. This road was finished and equipped in 157 days. The works covered so large an area that when the site was reached it was necessary to add 11 miles of construction railroad and equip it with 9 locomotives and 112 cars. It was necessary, also, to build two inclined cable railways, each rising 2,000 feet in 6,000 feet of length. These inclines, with concrete mixers, crushers and other machinery, required over 3,000 horse power of electric motors.

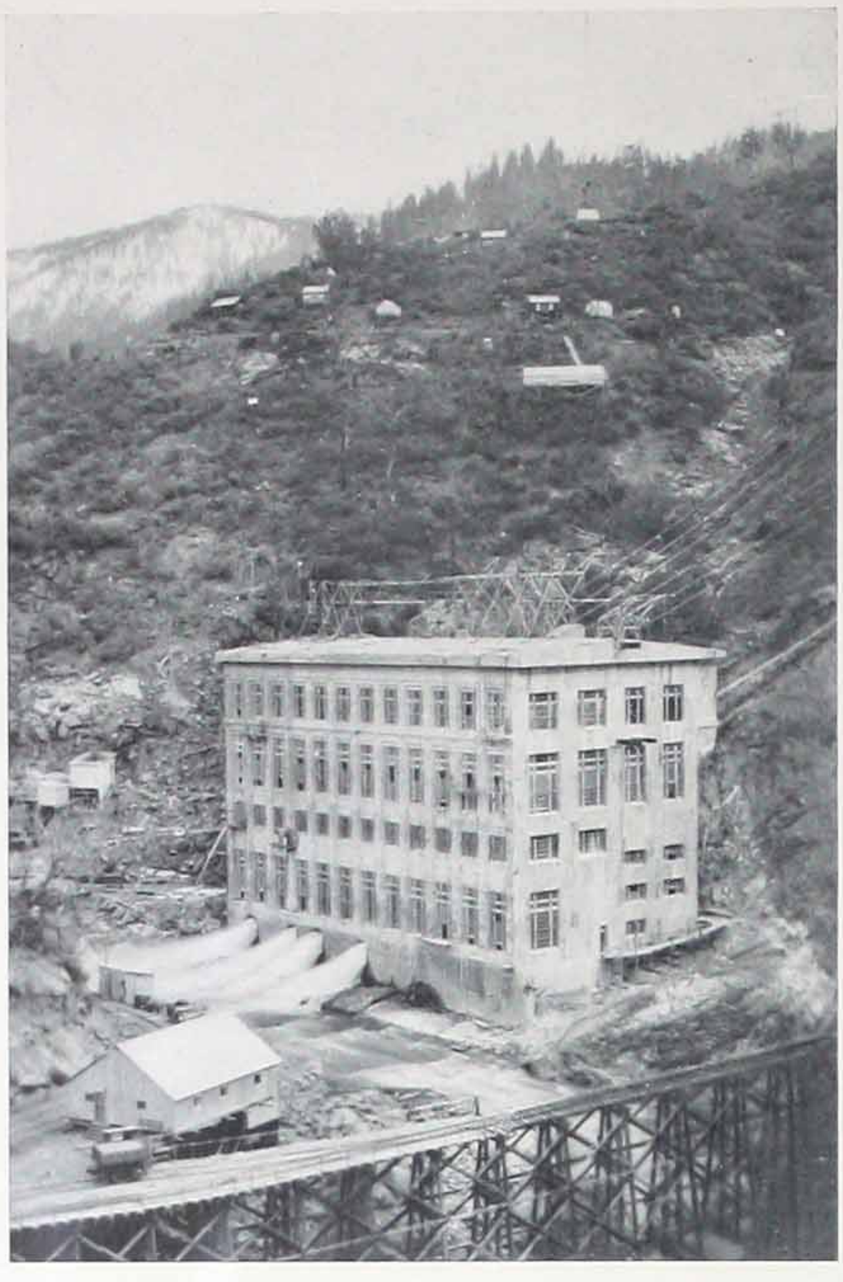
The work included the making of a reservoir 7,000 feet above the sea; the erection of four concrete dams; the construction of two power houses and a substation; the boring of five miles of tunnel through granite; the setting of over 3,000 steel towers over the mountains and across the desert, and the stringing of 5,000,000 pounds of aluminum cable.

However, in less than two years from the order to build the railroad to Big Creek and in less than a year and a half after work at Big Creek was begun, both power stations, one transmission line and a substation were in operation and the energy generated by Big Creek was in commercial use in Los Angeles.

The Kaiser Range of the Sierra-Nevada Mountains is a continuous ridge varying in elevation from 9,000 to 11,000



Dam No. 4 and Power House No. 1



Power House No. 2

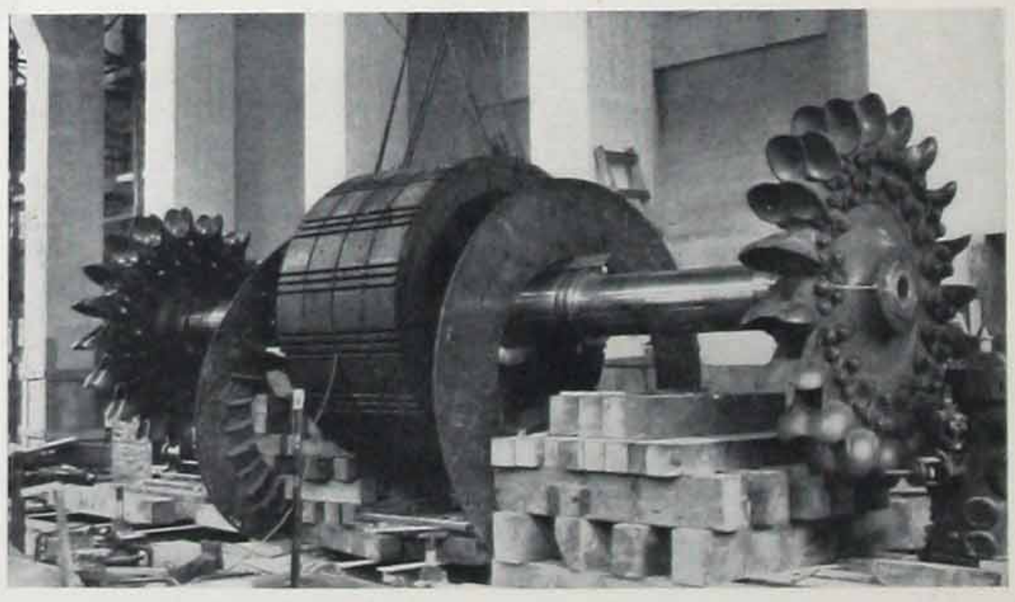
feet above sea level. It is a great condensing screen against which the moisture bearing winds of the Pacific precipitate winter snows and spring rains. Supplied by thaws and rainfall Big Creek has its source in this water-shed. At an elevation of 7,000 feet it flowed into a basin four miles long and then spilled over into a precipitous canyon, dropping four thousand feet in six miles before joining the San Joaquin River on its way to the Golden Gate. Three dams containing 125,000 cubic yards of concrete were built to close gaps in the walls of the basin, thus creating a lake of sufficient consequence to change the local maps. It is four and a half miles long and half a mile wide. Its banks are the ridges of the mountains. The dams are built on solid granite and are so constructed that fifty feet may be added to their height.

The fall of 4,000 feet has been utilized by diverting the water from its natural channel, leading it through a tunnel and steel pipes to the first power house halfway down and then through another series of conduits to the second power house.

The water from the reservoir flows through screens into an intake tower from which it enters a twelve foot tunnel three-quarters of a mile long. Connecting with the tunnel is a series of steel pipe conduits terminating at power house No. 1 in four six inch nozzles from which the water is driven at a velocity of 350 feet per second. These jets dash across an open space of a few inches and then strike the buckets of the water wheels. There is no shock, however, at this impact, as the part of the bucket first touched is nearly parallel to the jet. In its short course over the surface of the buckets the water is brought almost to rest and without pressure and velocity falls inert from the wheel into the tailrace.

There are two pairs of wheels in each station, each pair developing 23,500 horse power.

The control of pressure and the economical use of water at varying loads both have been



Placing wheels on shaft, Unit No. 1,
Power House No. 1

provided for. Each wheel unit has two governors so that the maximum efficiency can be obtained from the unit by using one or both runners according to the demand of the load. The size of the water jet is regulated by a needle valve controlled by the governor and excessive changes in pipe line pressures are prevented by by-pass openings back of the nozzles, also controlled by the governor.

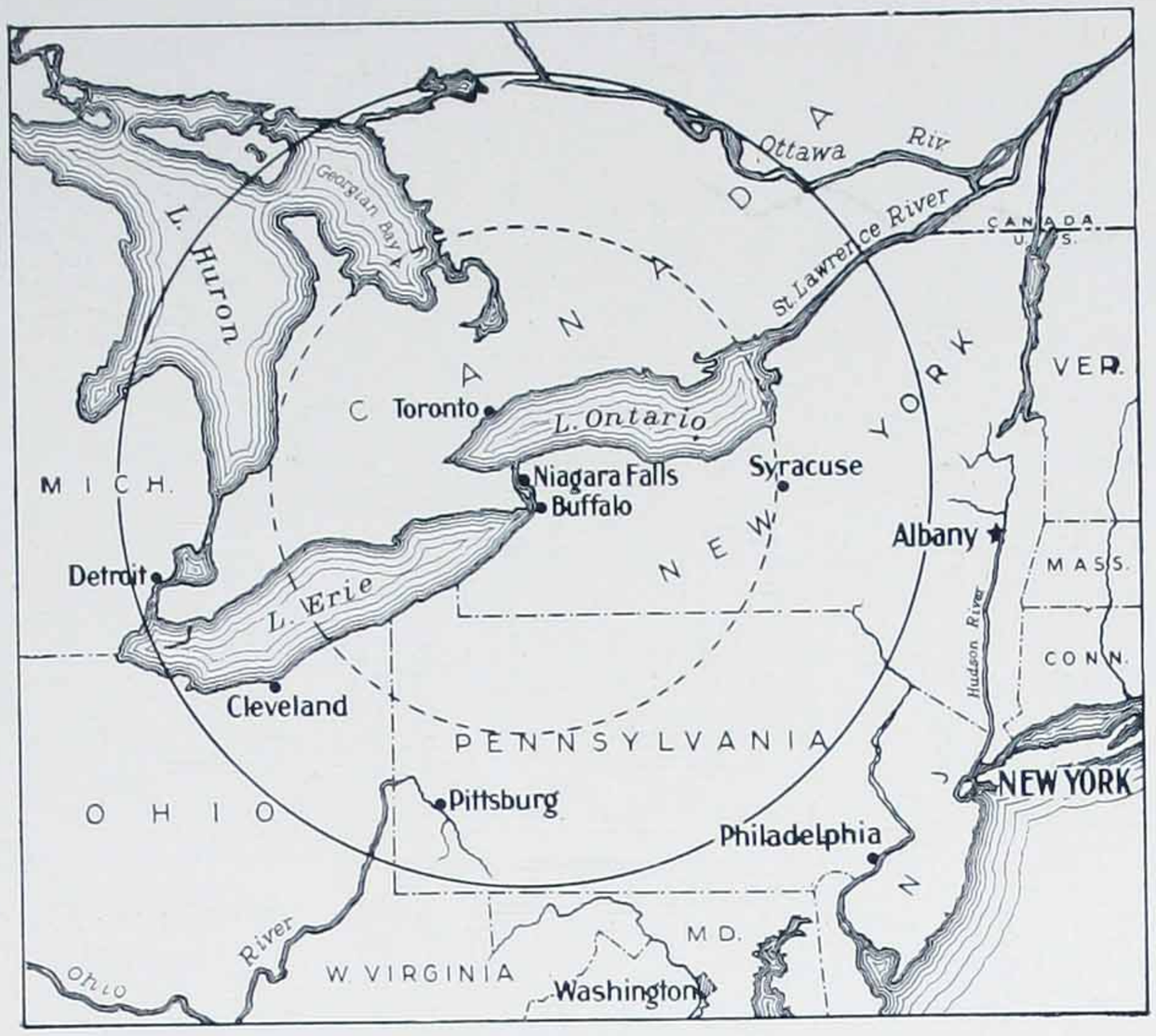


Diagram showing area which could be served from Niagara with lines as long as the Big Creek lines. Radius of dotted circle is longest transmission from Niagara

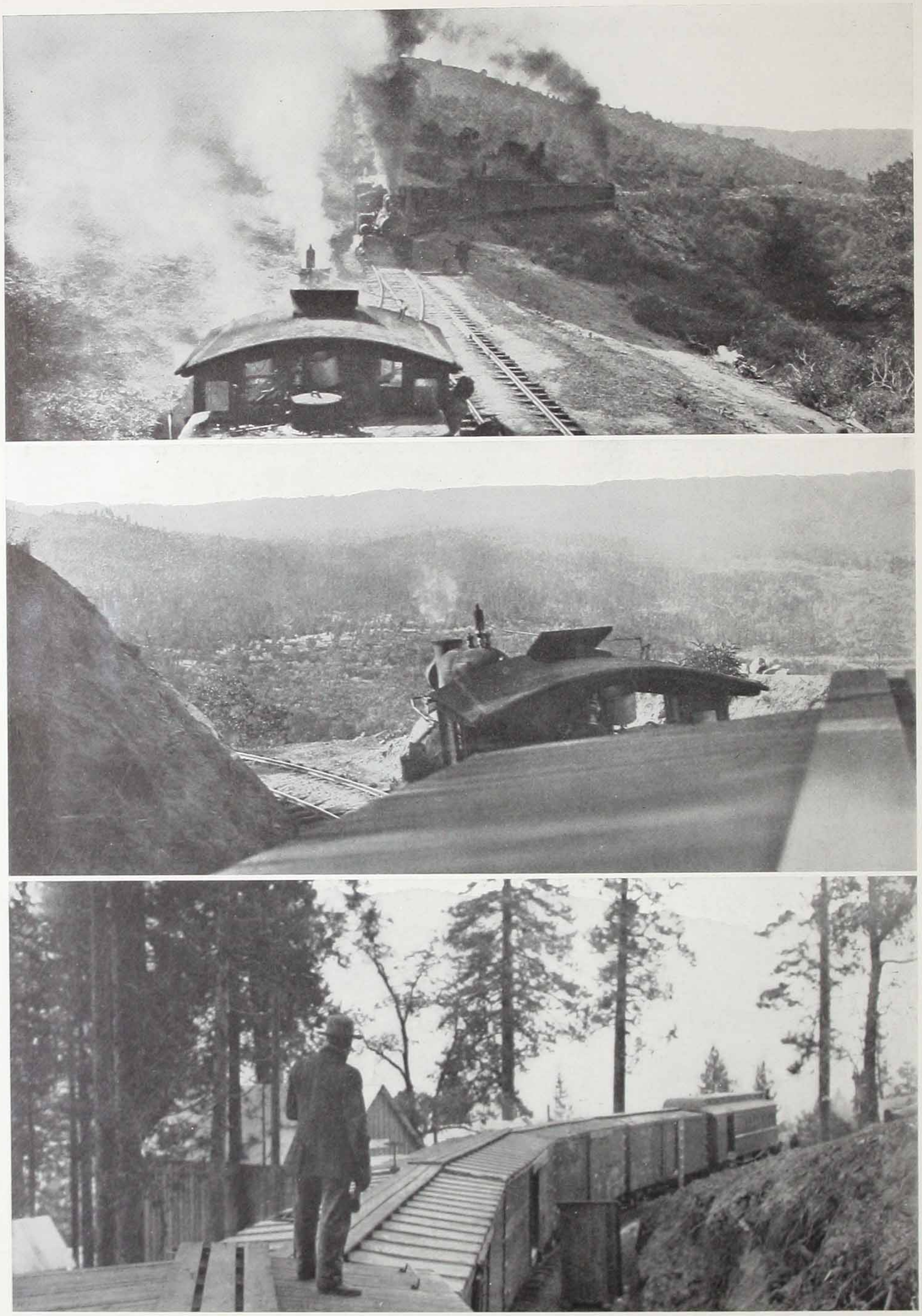
The water passing through the first power house is discharged into the Creek and then is taken through a second tunnel four miles in length into a second series of steel conduits which feed the wheels in the second power house, so that all of the energy due to the drop of 4,000 feet is extracted from the water before it is finally returned to its natural bed.

In each power house are two main generators of 17,500 kilowatts capacity each. Current is generated at 6,600 volts pressure and raised by the transformers to 150,000 volts for its 240 mile journey to Los Angeles.

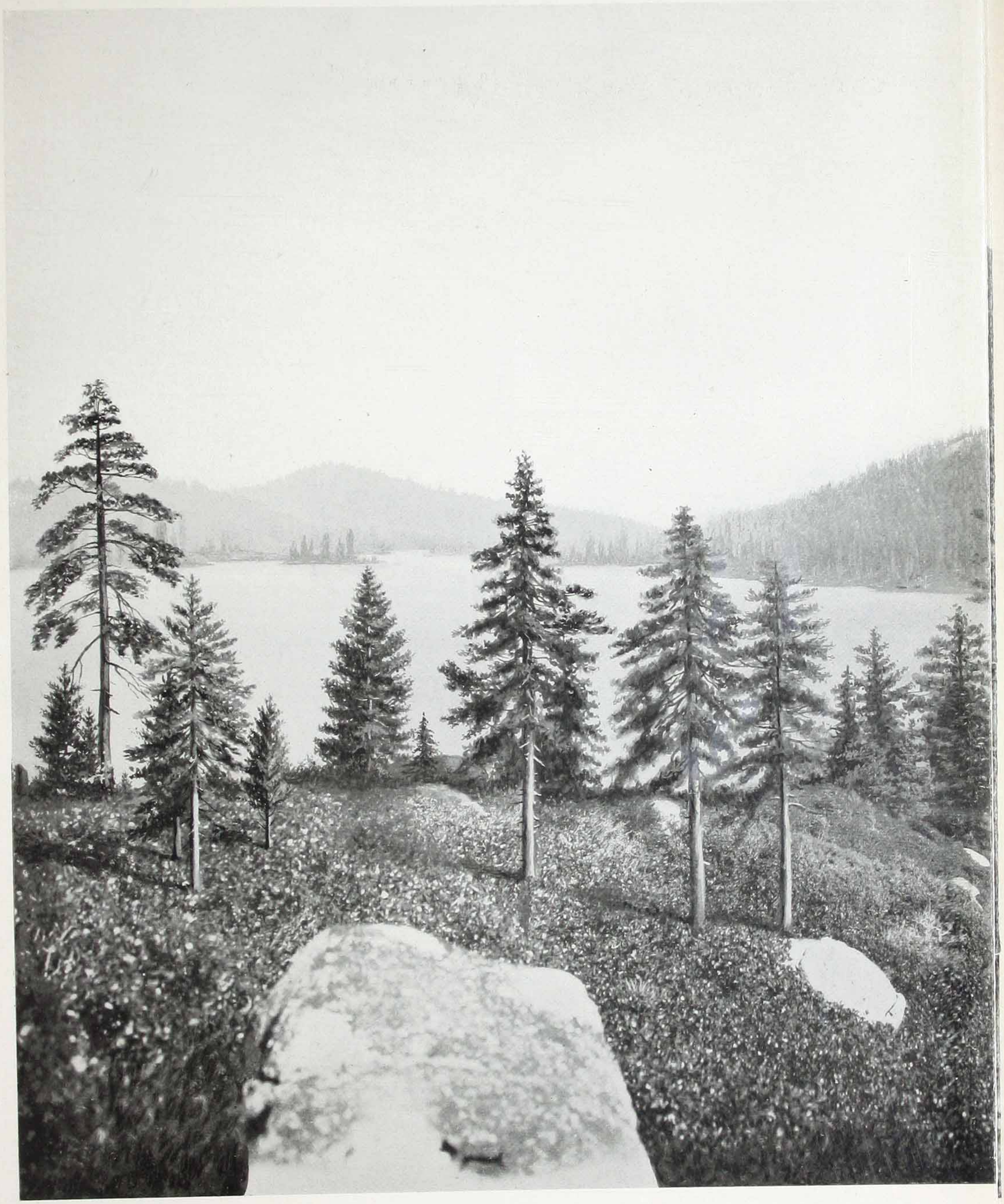
Two lines of steel towers, on a right-of-way 150 feet wide, will carry six cables one inch in diameter from the two power stations to the Eagle Rock substation in the suburbs of Los Angeles. The completed line withstood the test of the severe storms of the 1914 winter without interruption to service. Every other transmission line in the district was crippled seriously and for a time it was the only line over which power was coming into the territory it serves.

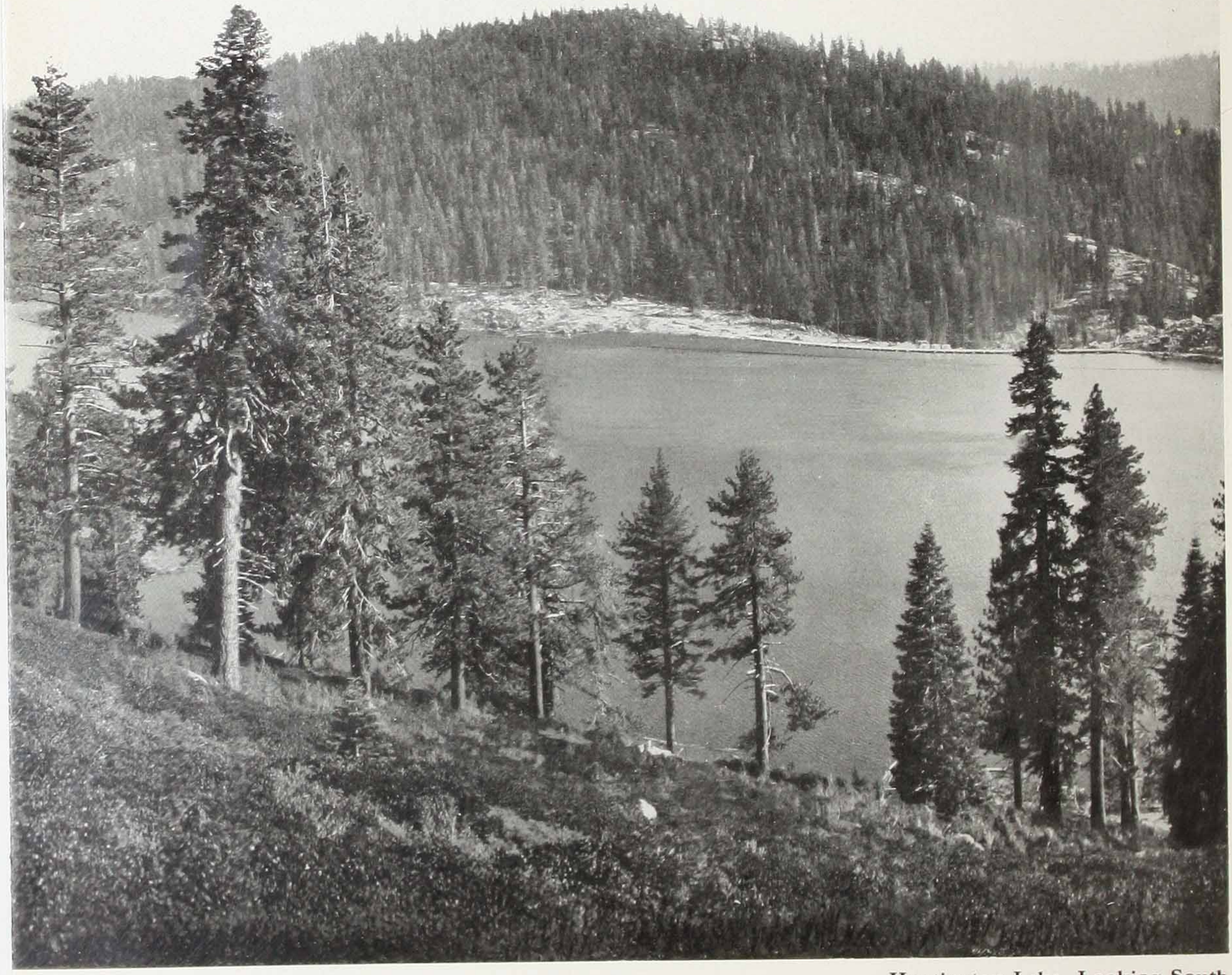
The Eagle Rock substation is a concrete building larger than the power stations and contains step-down transformers, condensers, compensators, and controlling apparatus. The energy, which comes in at 150,000 volts, is delivered to the Company's distributing lines at 72,000 and 18,000 volts.

An indication of the growing demand for power in the territory served is given by the fact that at the time work was begun, the plan was to provide 40,000 kilowatts of capacity. This plan was revised and the plant as built will deliver 60,000 kilowatts from the substation, with liberal provisions throughout for increases in capacity. To provide for future demands the transmission lines were built for three times the capacity which was first contemplated.



Along the San Joaquin & Eastern Railroad



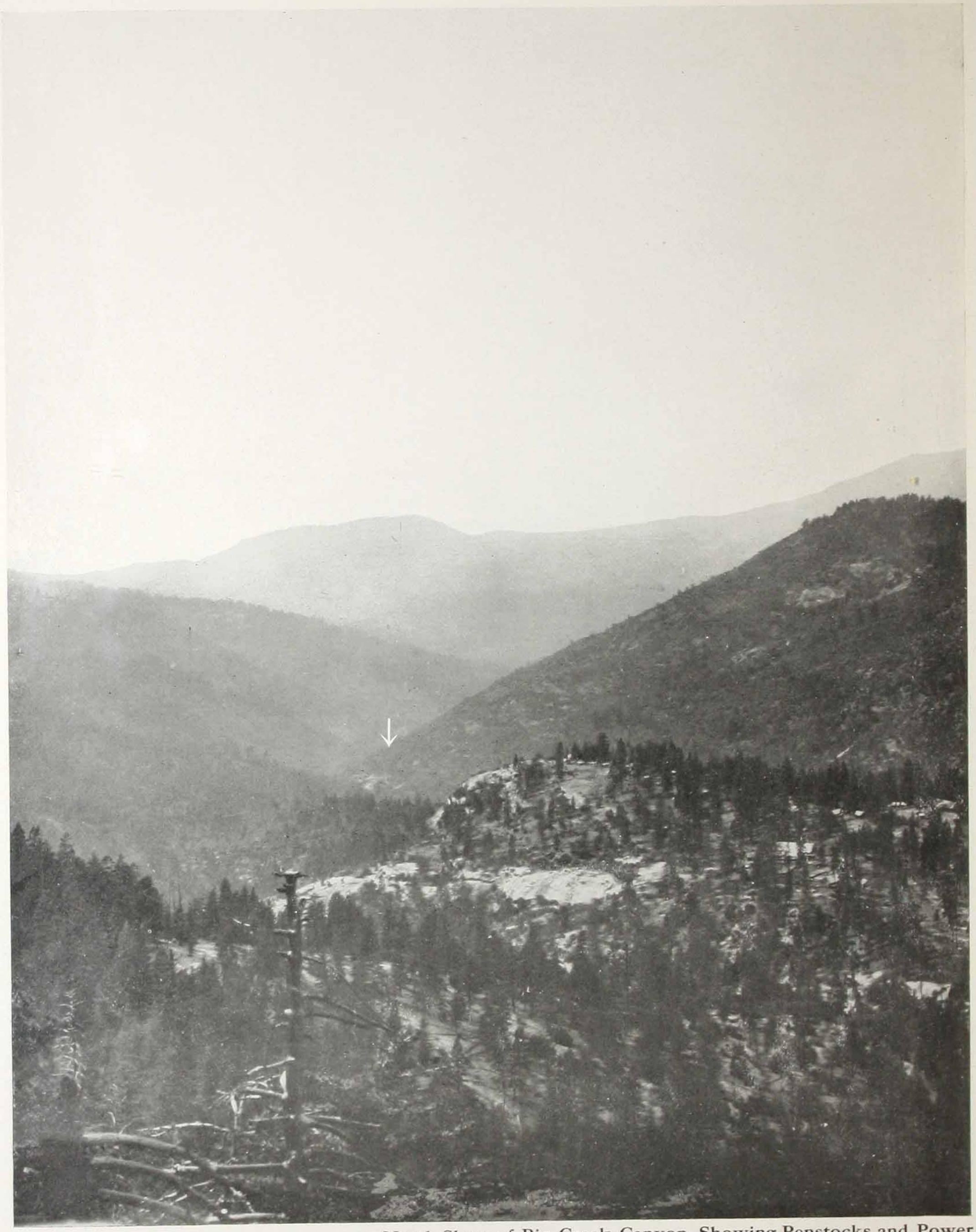


Huntington Lake, Looking South

The reservoir, created by the construction of three dams, is 4½ miles long, the ultimate capacity will be 105,000 acre feet. It is estimated that the present

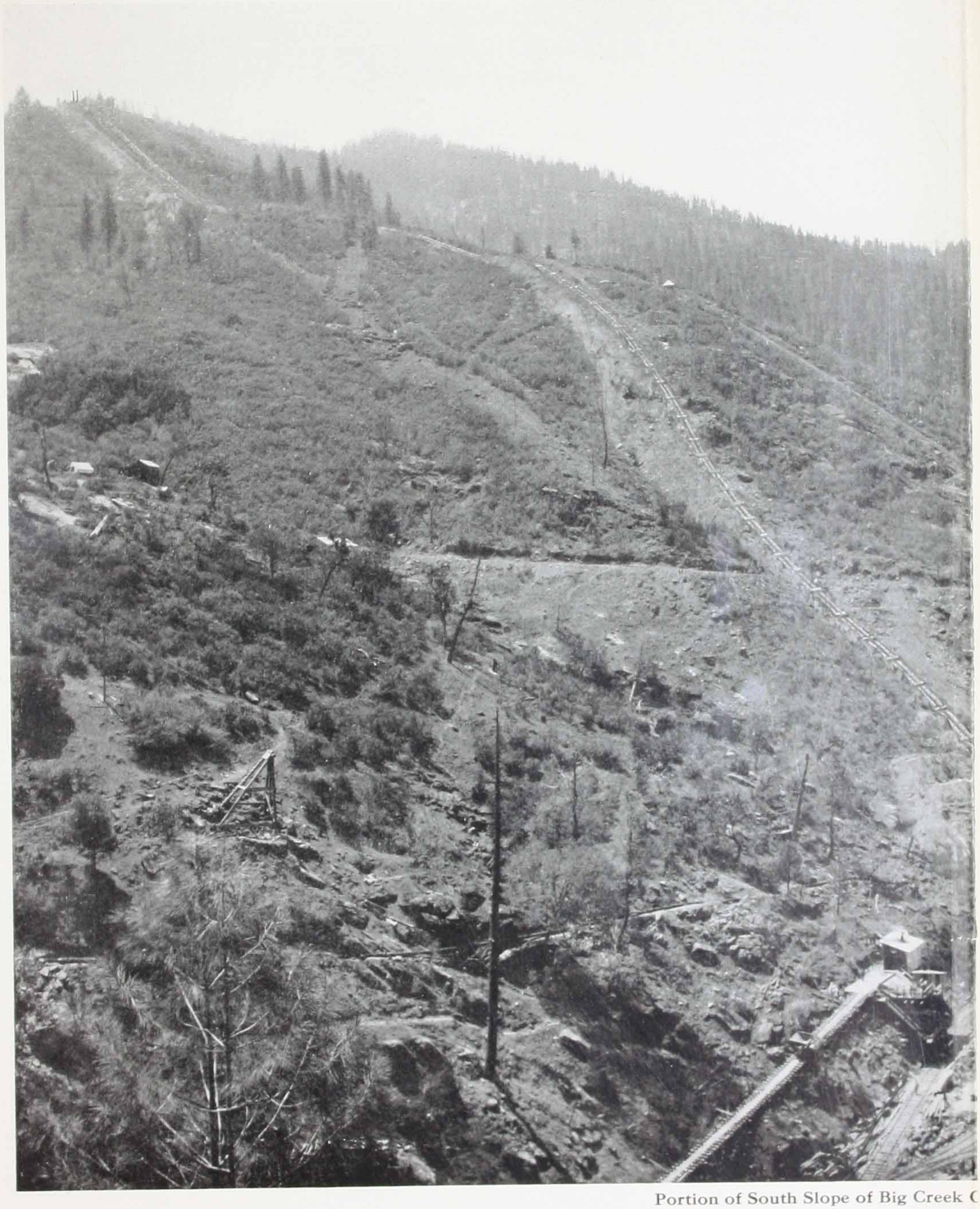
Power House Number One

Initial length 171 feet, height 103 feet, width 84 feet. Capacity 35,000 kilowatts



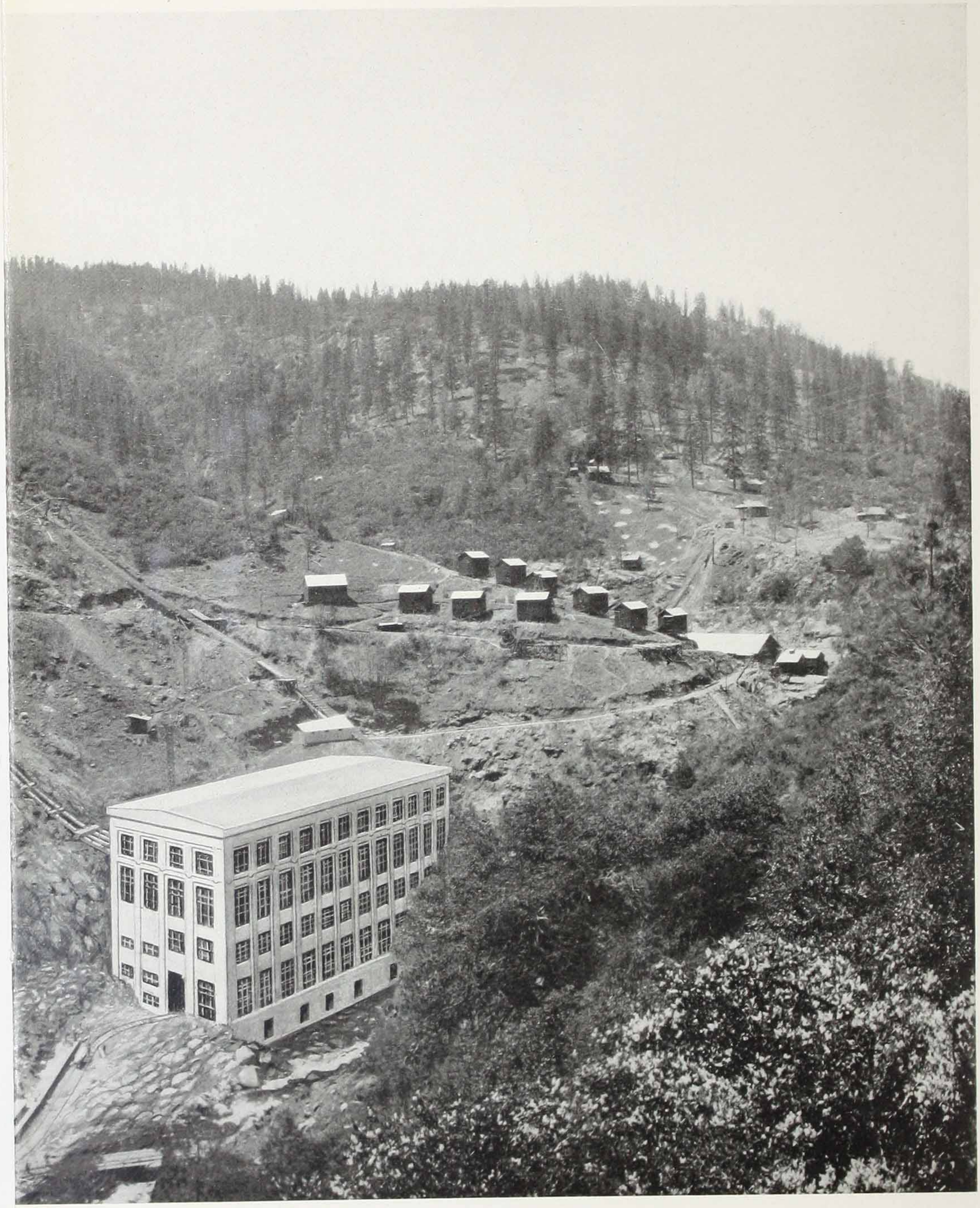
North Slope of Big Creek Canyon, Showing Penstocks and Power

Comparison of the Power House in the panorama with the near view of the
The location of Power House No. 2 is indicated by the arrow at the left. The

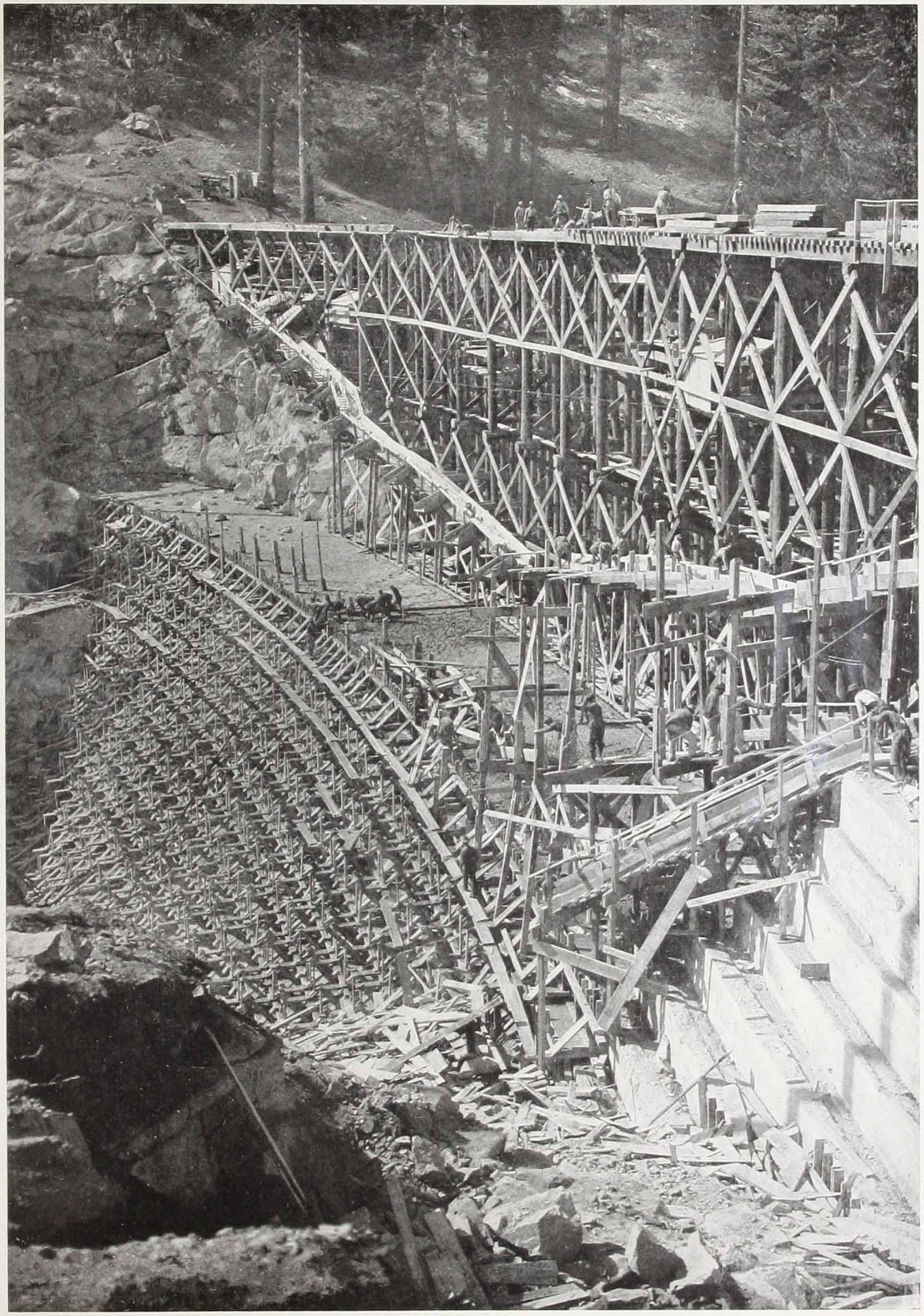


Portion of South Slope of Big Creek C

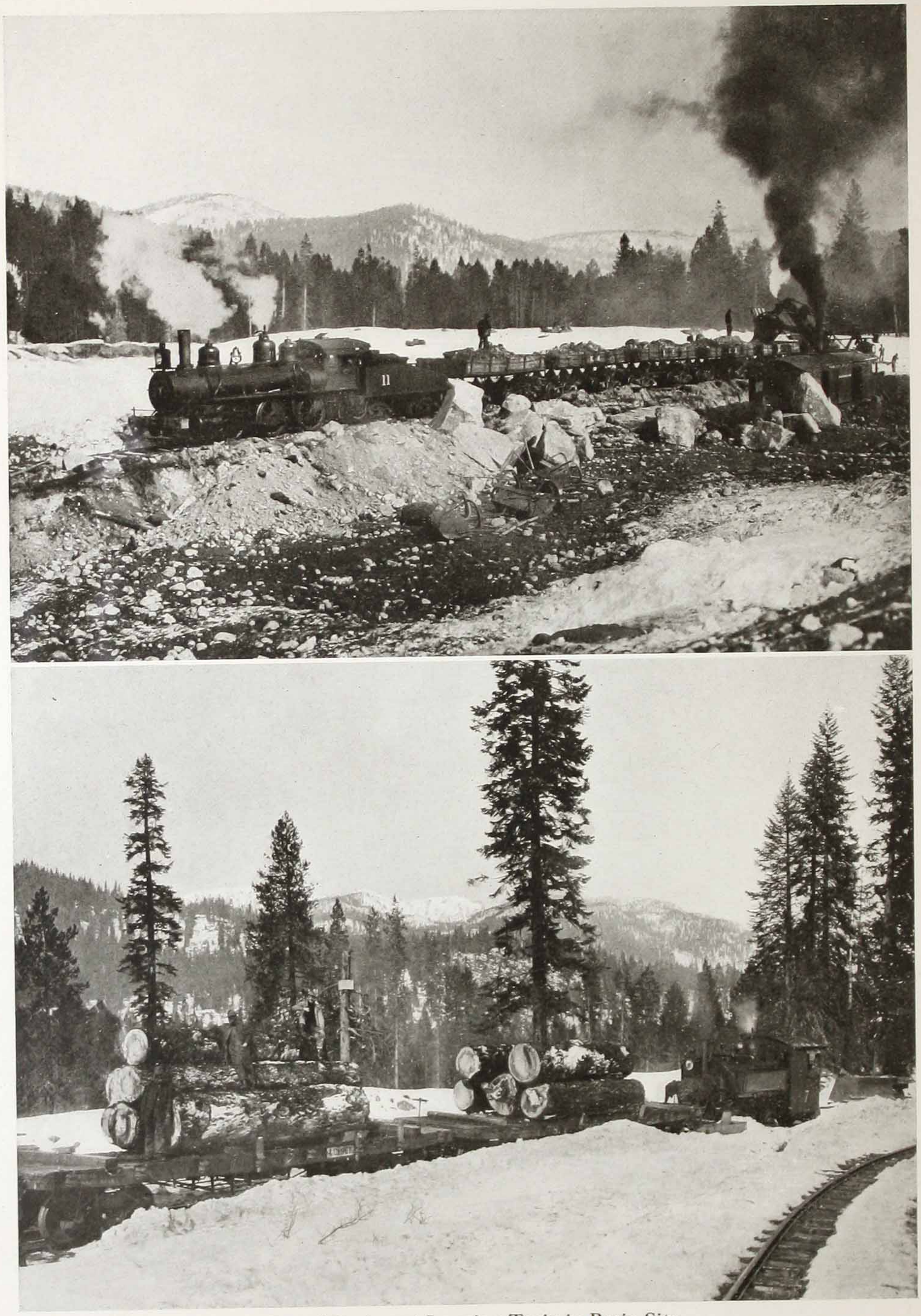
This view shows the Penstocks, making the second drop of 2,000 feet. The Power H



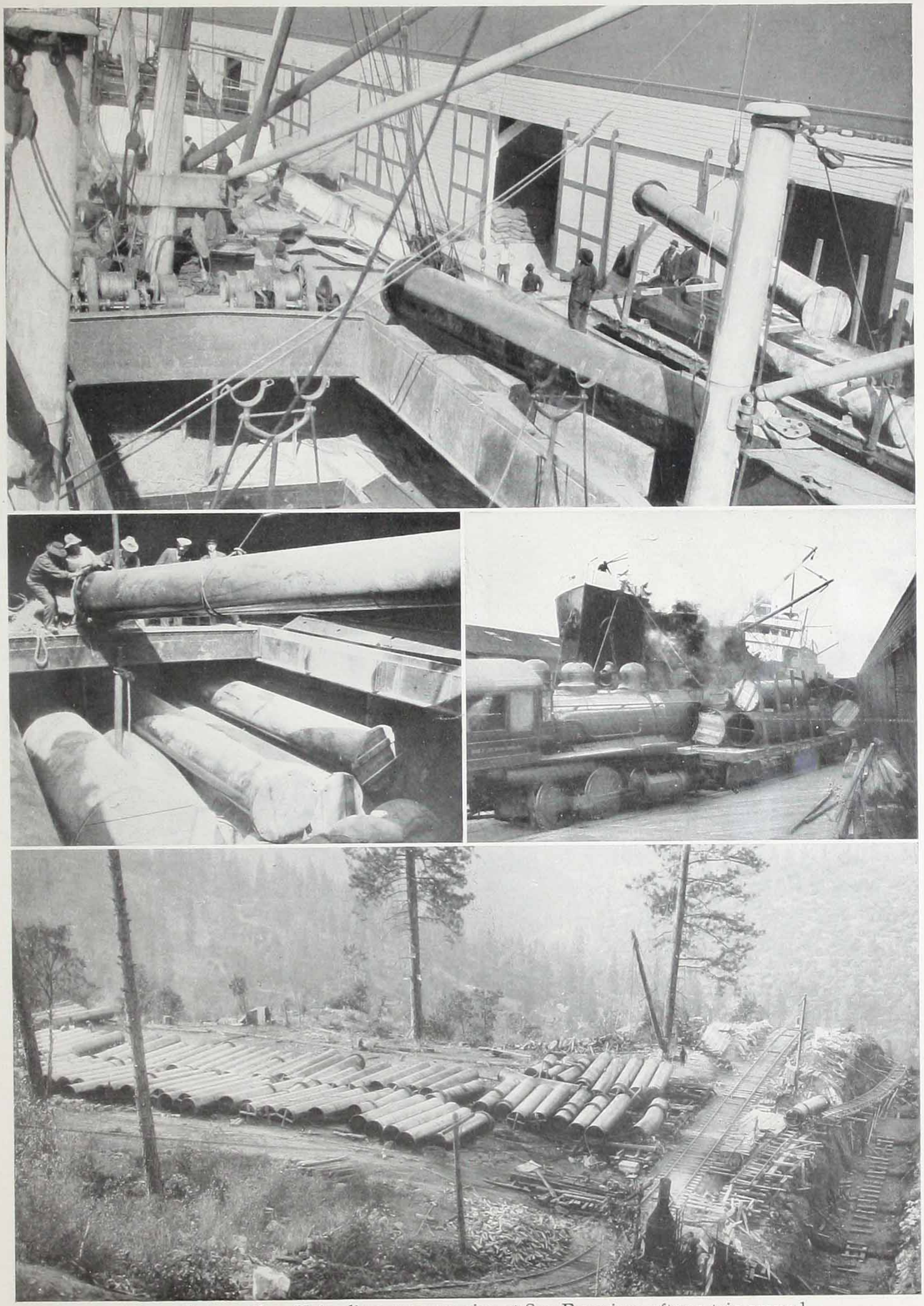
anyon at Power House Number Two
ouse is practically a duplicate in capacity and dimension of Power House Number One.



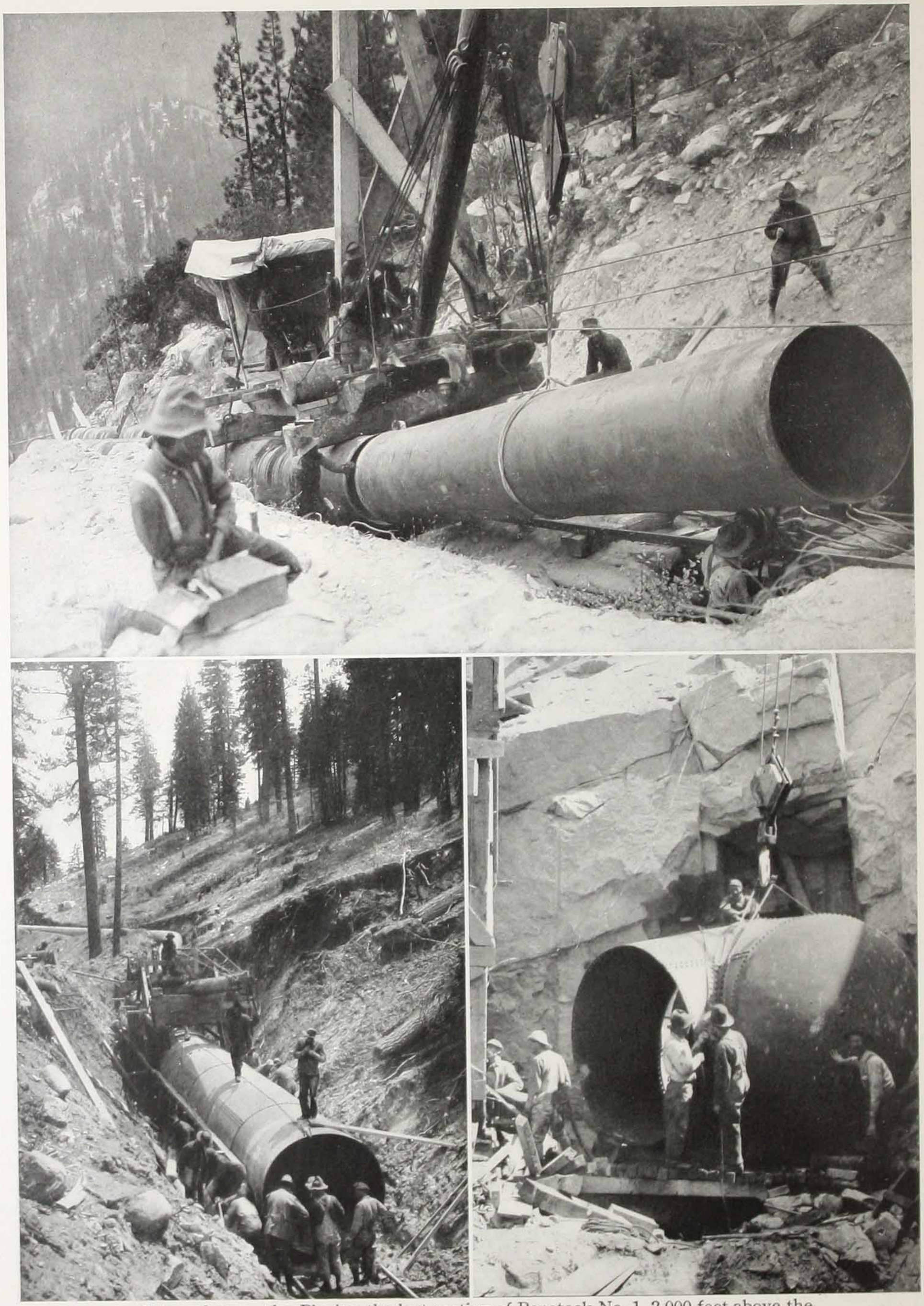
Construction Work on Dam 3



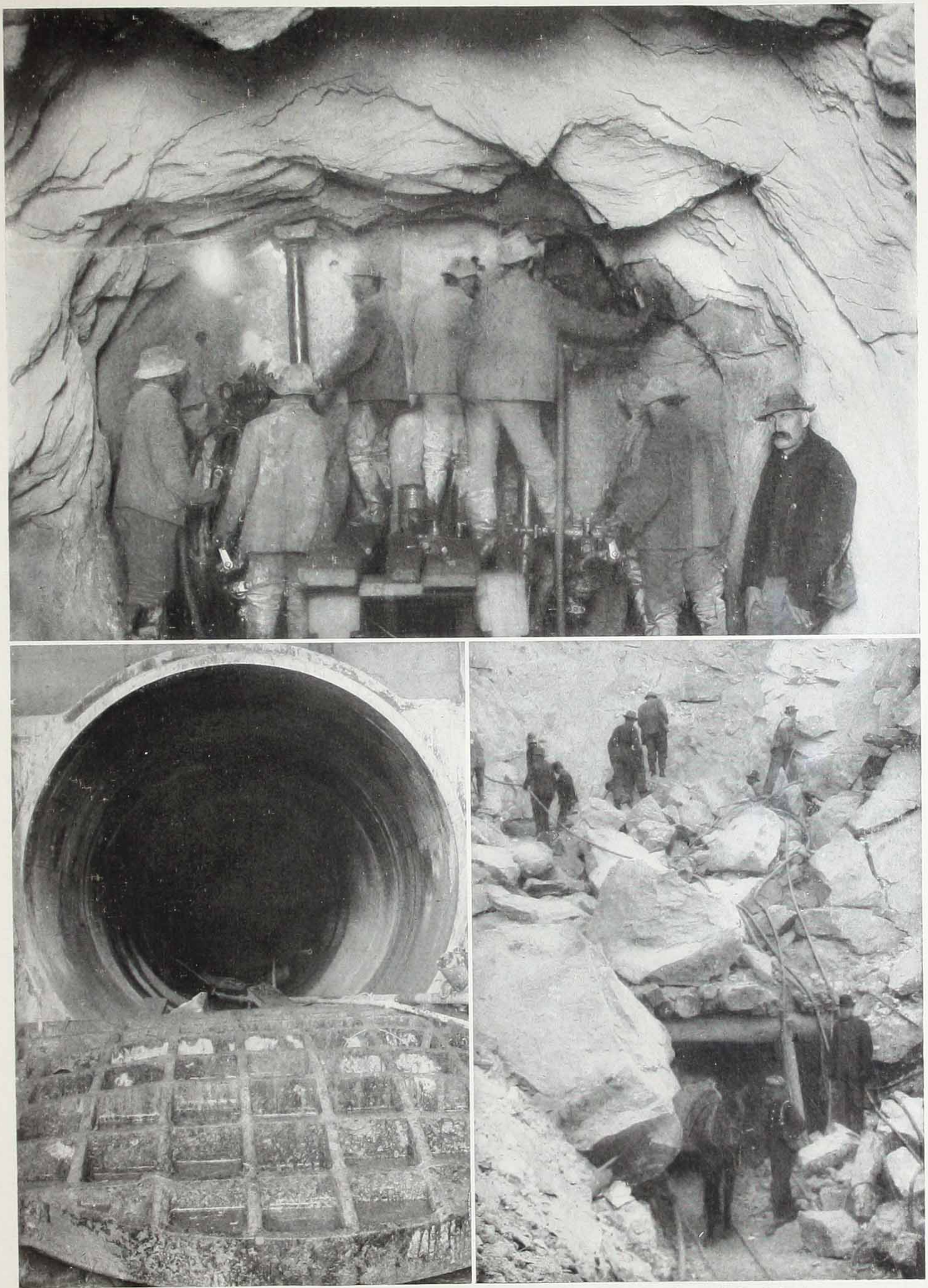
Gravel Train and Logging Train in Basin Site



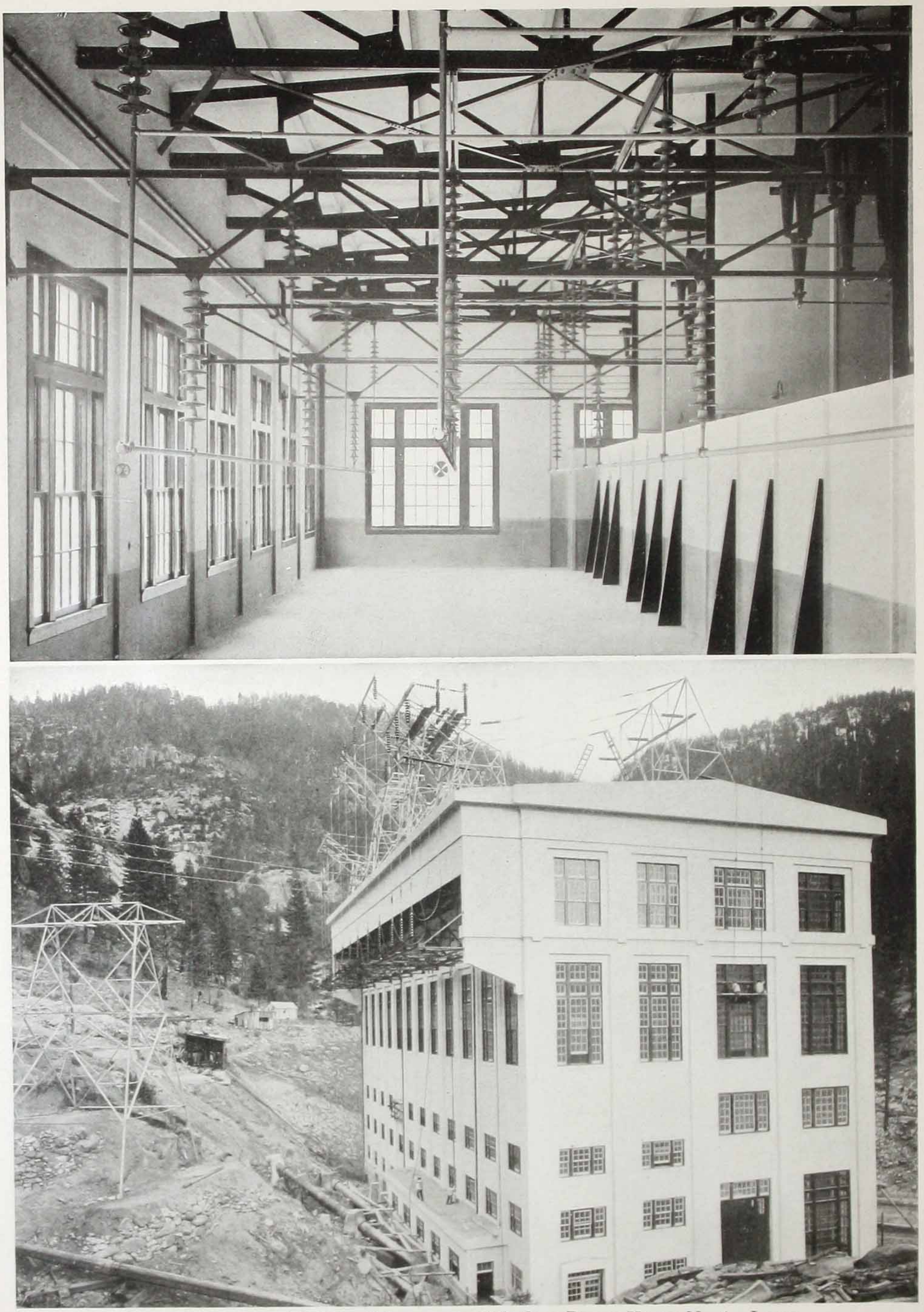
Upper photographs: Unloading pressure pipe at San Francisco after a trip around the Horn from Antwerp. *Lower photograph:* Pipe at the head of No. 2 incline ready for lowering into position



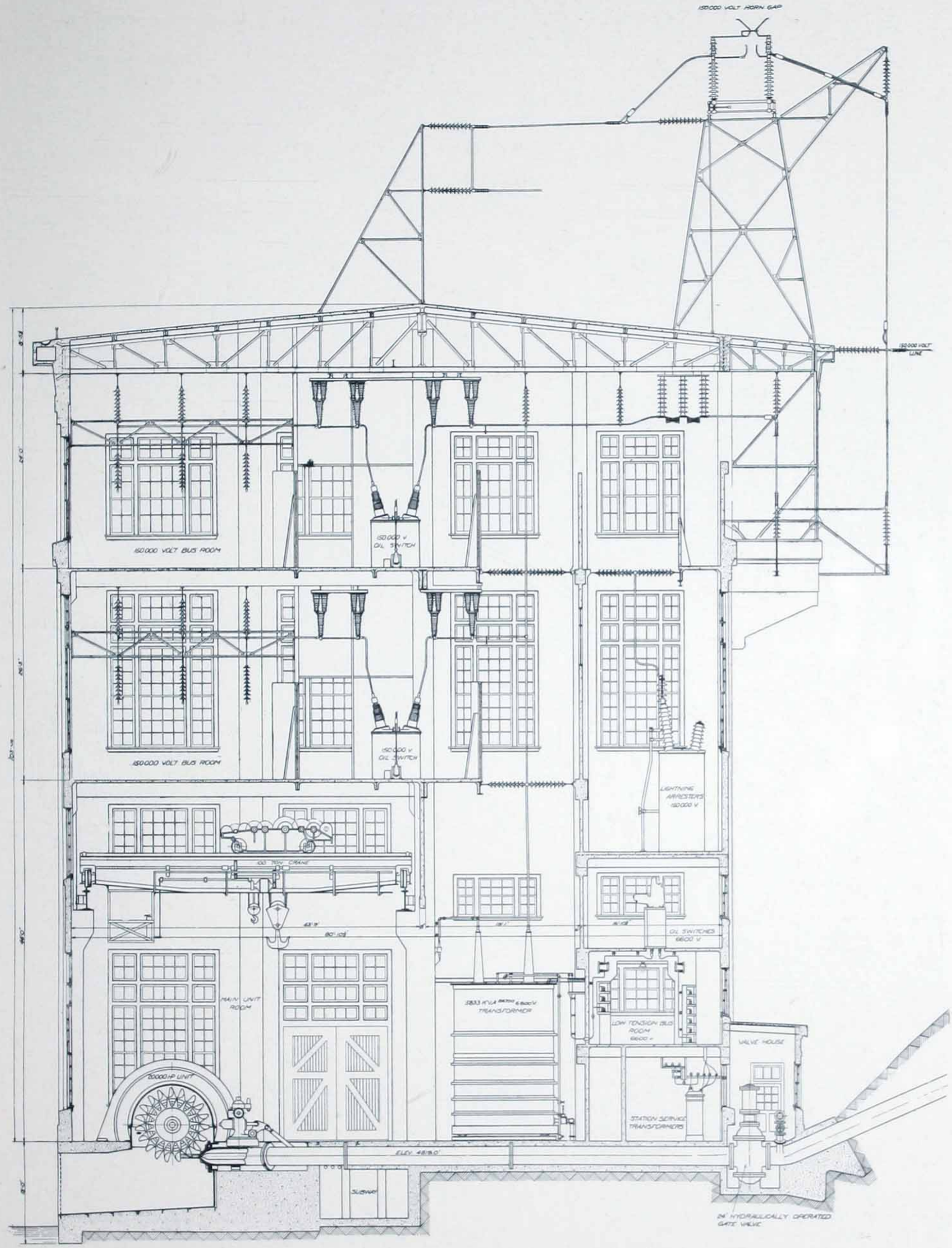
Upper photograph: Placing the last section of Penstock No. 1, 2,000 feet above the power house. *Lower left:* Laying flow pipe. *Lower right:* Placing steel "Y" for beginning of flow-pipe at exit of Tunnel No. 1



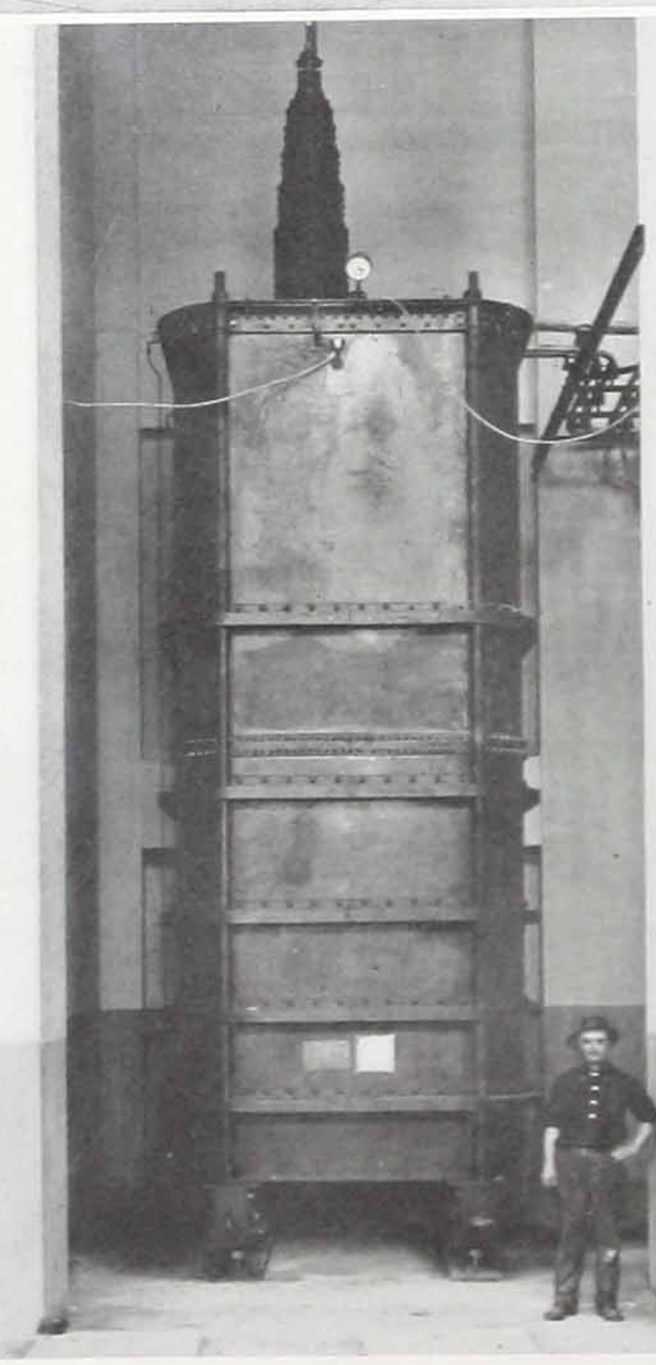
Upper photograph : Three drills at work on Adit 5, Tunnel No. 2. *Lower left :* 9-foot gate at the entrance of Tunnel No. 1. *Lower right :* Excavation for portal and intake, Tunnel No. 1

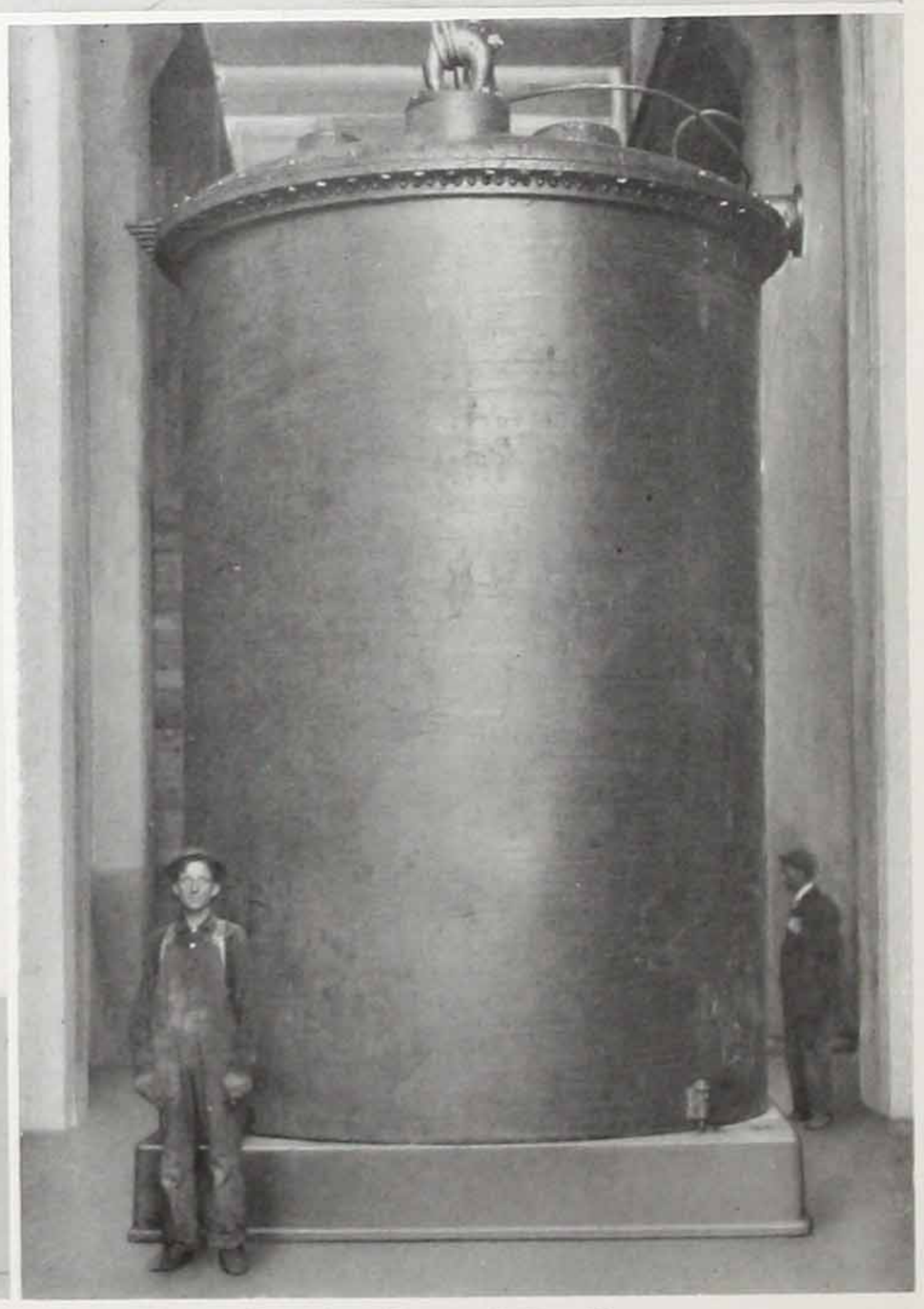


Upper photograph: 150,000-volt bus room, fifth floor Power House No. 1. *Lower photograph:* Power House No. 1, looking East

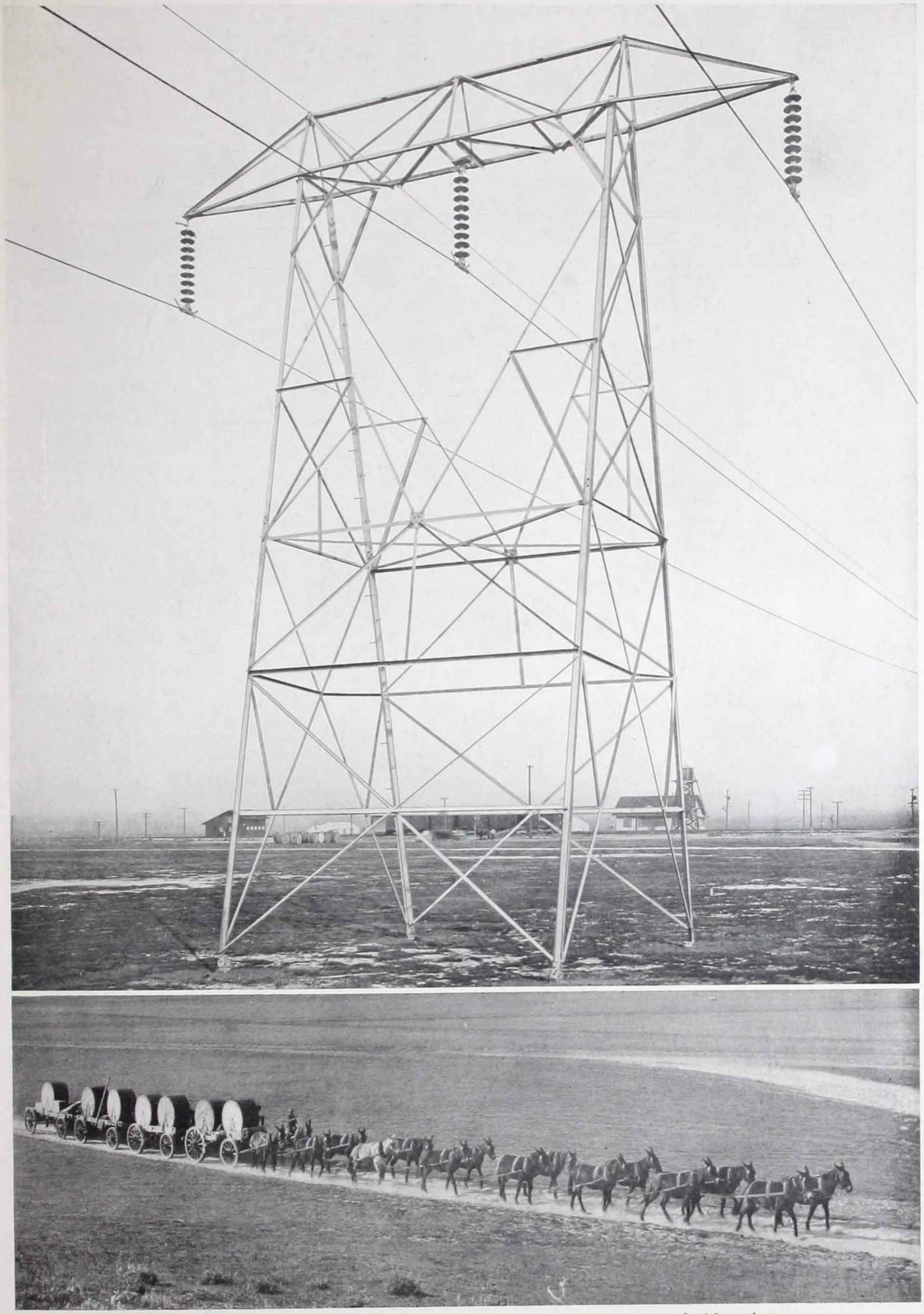


Cross Section Power House No. 1

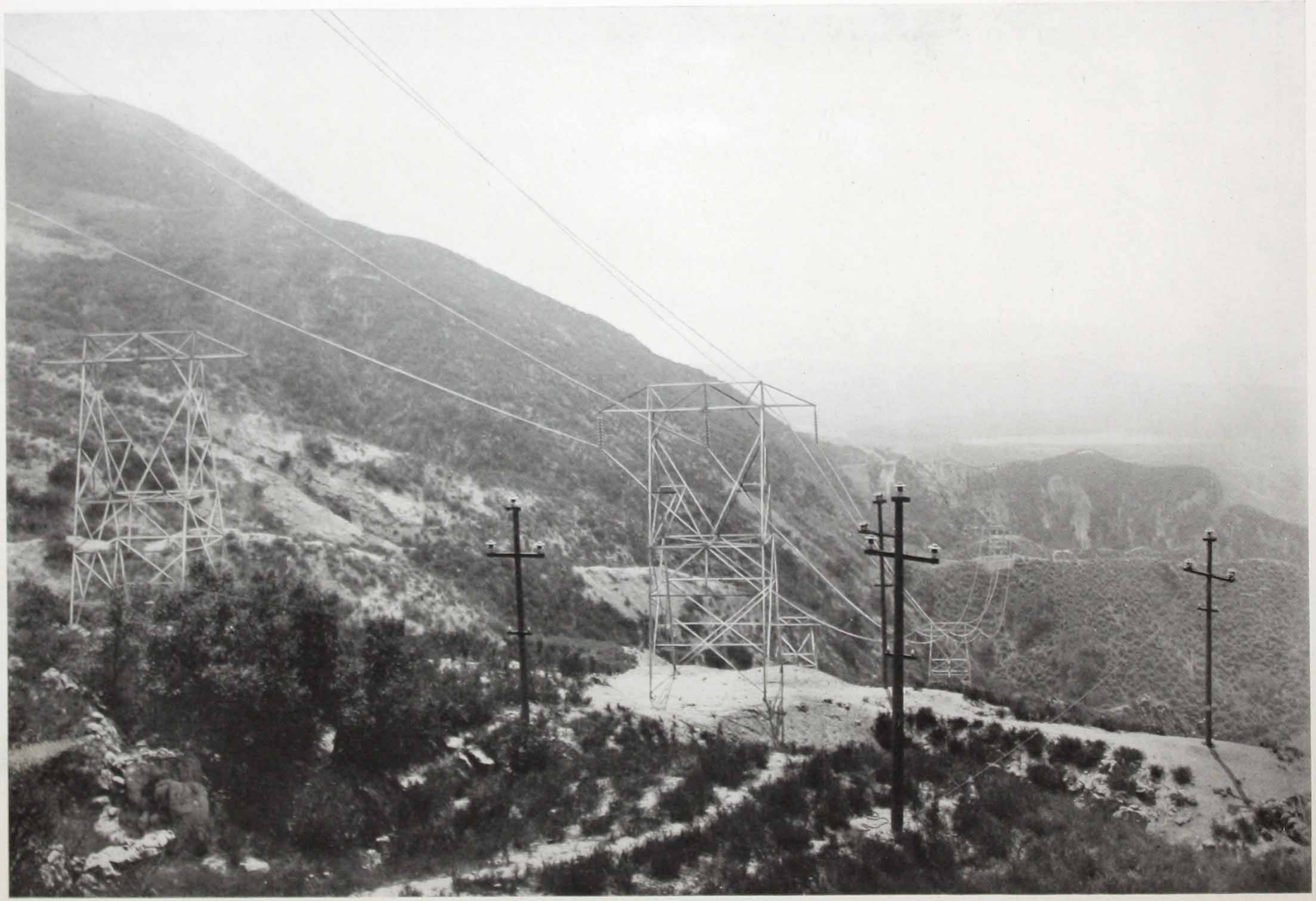




Upper photograph: Units Nos. 1 and 2, Power House No. 1. *Lower left:* Transformer, Power House No. 1. *Lower right:* Transformer, Power House No. 2

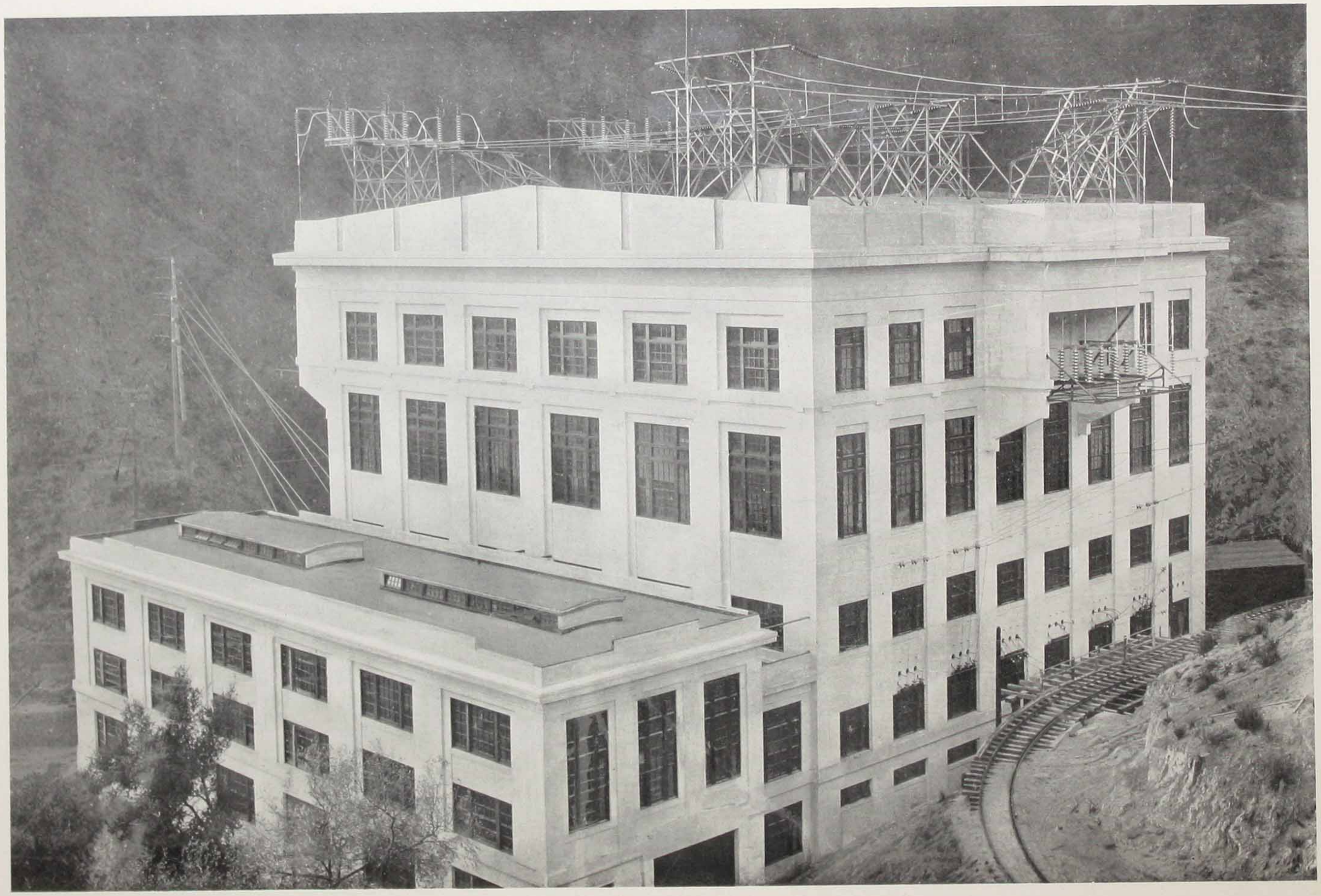


Upper photograph: Standard Transmission Tower. *Lower photograph:* 16-mule team hauling aluminum cable. 4,892,000 pounds of cable were used, requiring 1500 reels

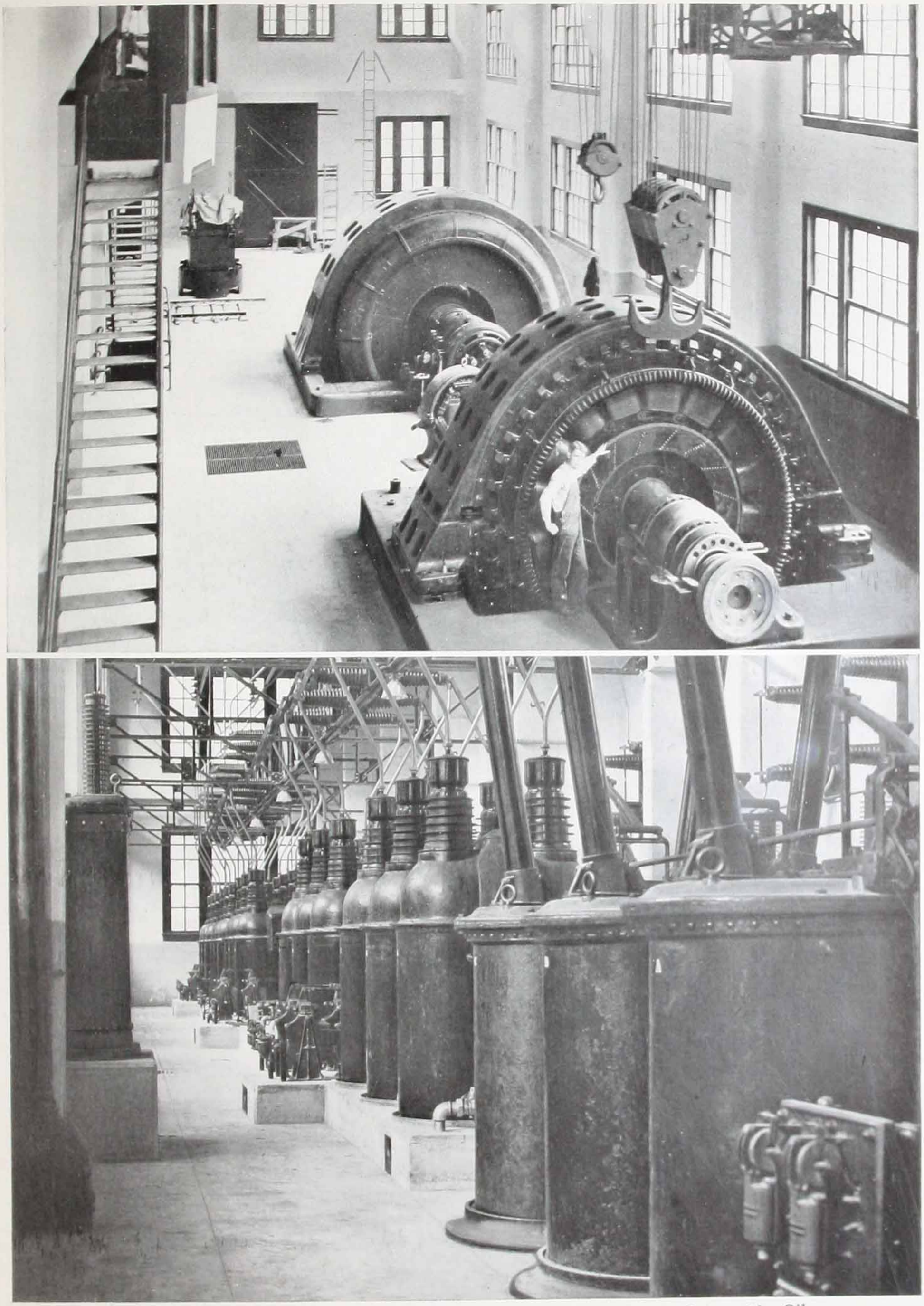


Transmission Lines, Looking South from Newhall Divide

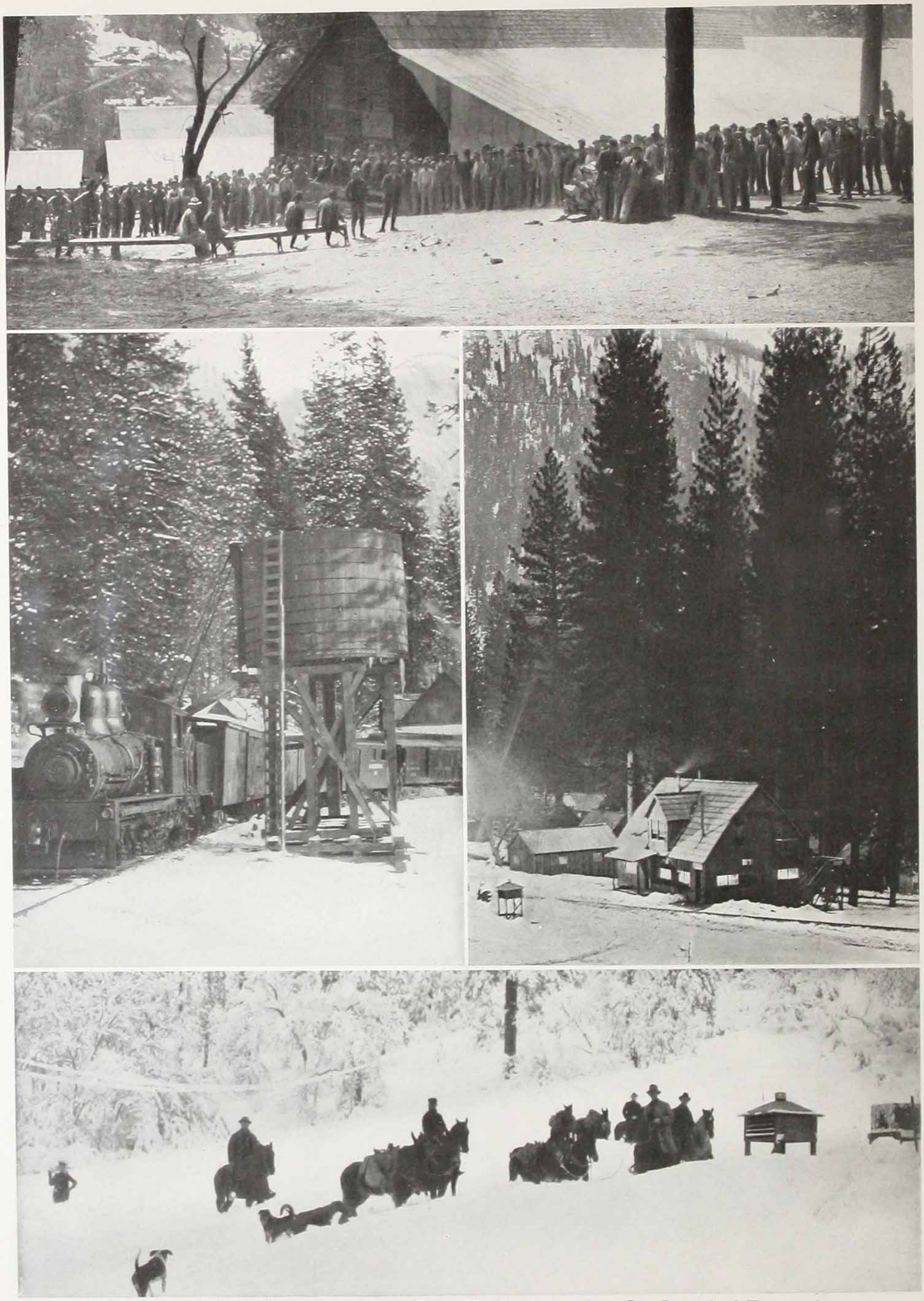
Transmission Lines, Looking North from Newhall



Eagle Rock Substation, 168 feet in length, 131 feet in width, 106 feet in height



Upper photograph : Condensers at Eagle Rock Substation. *Lower photograph :* Oil and disconnecting switches, Eagle Rock Substation



Upper photograph: Dinner time at Camp No. 2. *Central left:* San Joaquin & Eastern Railroad train at Cascada, Kerckhoff Dome in background. *Central right:* Camp No. 2 headquarters at night. *Lower photograph:* Snow scene in the high Sierras

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